WHITE PAPER

FROM REACTIVE TO PREEMPTIVE:

Xiid's Terniion™ Redefines Enterprise Cybersecurity Defense

Abstract

Traditional cybersecurity approaches including endpoint detection and response, vulnerability management, and classic Zero Trust struggle to keep pace with threats posed by AI and the expanding global attack surface. As attackers leverage these tools to automate exploitation, these legacy, reactive methods respond only after compromise, introduce dangerous visibility gaps, and suffer from lag. Xiid's Terniion redefines the security paradigm by making resources undiscoverable and unreachable, architecting a proactive, preemptive posture.

Terniion eliminates the need for open inbound firewall ports, credential federation, and trust in black-box analytics. This white paper details Xiid's approach, demonstrating how preemptive methods outpace and outlast yesterday's detection-and-response standards, delivering enterprise security that is secure by design and unreachable for attackers.

The growth and success of networking and IT architectures face obstacles due to the complexity and disparity of resources across enterprise networks and the diffusion of the network perimeter.

Reactive vs. Preemptive Cybersecurity

Reactive cybersecurity tools like endpoint detection and vulnerability management are designed to wait for an attack to happen before they respond, but today's AI-driven threats move too quickly for such post-breach methods to keep up. Attackers can compromise systems and move laterally within minutes or even seconds, often eluding traditional tools until damage is already underway. Consequently, these defenses are becoming increasingly outmatched by rapid, automated exploits.

Conversely, preemptive cybersecurity reverses the script by proactively preventing attackers from gaining access to systems by utilizing denial-by-default, deception, and predictive intelligence to render them undetectable prior to any compromise. This posture dramatically reduces the opportunity for advers

Gartner predicts that by 2030, preemptive cybersecurity will comprise at least 50% of all IT security spending, signaling the end of legacy detection-and-response as the go-to cyber defense model and establishing preemptive strategies, like Terniion, as the new gold standard.[1]

The Limits of Traditional Perimeter Security

For many years, network security was relatively straightforward. Preventive measures focused on protecting the private, internal enterprise network perimeter, since employees physically worked from the office and used digital resources located within the internal network. As a result, traffic inside the internal network was largely deemed "safe", and activity coming from the outside internet was untrusted and could be blocked. Over time, this "castle-and-moat" approach to cybersecurity, known as perimeter security, started to break down.

Market shifts and workplace trends expanded the network perimeter, complicating the cybersecurity landscape and exposing the vulnerabilities of perimeter security. The rapid adoption of cloud services, SaaS/XaaS offerings, and microservices led to a "hybrid cloud" enterprise infrastructure, with many key resources no longer residing within the internal network. Savings were realized through Bring Your Own Device (BYOD) programs, at the cost of relinquishing tight control over devices connecting to corporate resources and an increased risk of insider threats. More people began working remotely, and COVID-19 amplified a work-from-home trend that may never fully reverse.[2]

1 https://www.gartner.com/en/newsroom/press-releases/2025-09-18-gartner-says-that-in-the-age-of-genai-preemptive-capabilities-not-detection-and-response-are-the-future-of-cybersecurity

2 https://www.pewresearch.org/social-trends/2022/02/16/covid-19-pandemic-continues-to-reshape-work-in-america/

With the vulnerable enterprise network "perimeter" becoming so diffused as to be rendered ineffective on its own, a new paradigm, Zero Trust Network Access (ZTNA), arose to deliver security without needing to assume a perimeter exists at all. ZTNA, also referred to as Zero Trust, is a "never trust, always verify" approach to cybersecurity, distrusting users and devices equally and making no security distinction between the internet and intranet.[3]

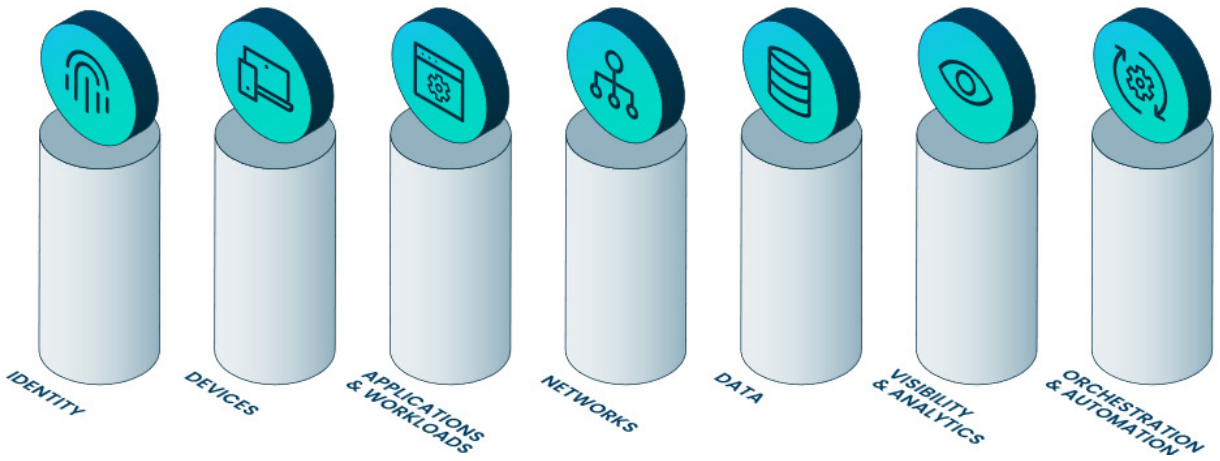
While perimeter security focused on connecting people to networks, in practice, Zero Trust instead connects people directly to the resources they need to use and re-authenticates them before each session.

Over the past decade, the number of ZTNA solutions available in the market skyrocketed, as numerous vendors launched products claiming to quickly make an organization's architecture "Zero Trust". In 2021, an Executive Order issued in the United States directed Federal Government agencies to "...advance toward Zero Trust Architecture", further demonstrating a recognition of the increase in cyber risks and advanced cyber adversaries and the growing demand for ZTNA in both the public and private sectors.[4]

Where Commercial ZTNA Falls Short

To standardize the meaning of Zero Trust industry-wide, the National Institute of Standards and Technology (NIST) published a set of tenets that an architecture should follow to be considered Zero Trust. These tenets include controlling access on a per-resource basis, securing communication regardless of a device's location, using a dynamic security policy, and monitoring the integrity of devices that use enterprise resources.[5] Unfortunately, many ZTNA solutions in the market do not fully meet this NIST standard.

SEVEN PILLARS OF ZERO TRUST



3 https://www.nist.gov/blogs/taking-measure/zero-trust-cybersecurity-never-trust-always-verify

4 https://www.whitehouse.gov/briefng-room/presidential-actions/2021/05/12/executive-order-on-improving-the-nations-cybersecurity/

5 https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-207.pdf

While most ZTNA implementations offer substantial improvements over perimeter-based security models, they are not "one-shot fixes" to all cybersecurity concerns. The architectural designs of many ZTNA products, even those meeting the NIST standard, often suffer from several common, significant vulnerabilities:

Third-Party Data Federation

To provide authentication services, vendors frequently require organizations to entrust them with full copies of LDAP directories to store in the vendor's data centers. Trust must be placed in the vendor to protect this highly sensitive enterprise data not only at-rest, but also in-transit, both during the servicing of authentication requests and the syncing of directory data to and from the organization. A misconfigured sync could accidentally expose sensitive data, and holding volumes of sensitive data from multiple organizations in vendor clouds makes the vendors themselves an alluring target for cybercriminals.

Use of "Break-and-Inspect"

Many vendors tout their capability to defeat the encryption of enterprise web traffic to scan it for malware or other undesired content, and if done well, this feature can be valuable and effective, albeit risky. Enabling "break-and-inspect" allows the vendor, and any attacker who has breached the vendor, to have full access to all secrets, secure communication, and other sensitive enterprise information traveling across the internet or private network.

Requiring Open Inbound Firewall Ports

To provide authentication services, sync directories to the vendor's data centers, or enable other functionality like tunneling or remote desktop, nearly all vendors require the enterprise to open inbound firewall ports on their private network, such as the often-exploited port 443.[6]

Open inbound ports represent a substantial vulnerability and are among the first places attackers attempt to breach when trying to infiltrate an organization. To mitigate this, ZTNA vendors offer "AI-enabled" firewall products that attempt to manage a complex set of firewall rules to thwart attackers.

However, these "AI" models are often imprecise, so an organization must entrust the security and reliability of their enterprise networks to the decisions the models make.

These aspects of many commercial ZTNA products conflict with the implication of "Zero Trust" – that no entity is trusted. Instead, nearly limitless trust must be placed by an enterprise or agency in the ZTNA vendor themselves. While the original intent of Zero Trust – "never trust, always verify" – is laudable, not all ZTNA solutions in the market are successful at achieving this goal.

Terniion's new approach using SealedTunnel™ technology has emerged to conform to, overlay, and dramatically improve upon the NIST Zero Trust Architecture standard, delivering the initial promise of ZTNA while solving the fundamental security concerns with real-world ZTNA solutions.

6 https://cve.mitre.org/cgi-bin/cvekey.cgi?keyword=443

Addressing Key ZTNA Vulnerabilities

Real zero trust security, even against vendors

Terniion guarantees that all parties – the endpoints and the vendor in-between – have no excessive knowledge of each other's sensitive data or location, eliminating vulnerabilities in a way that's proactive, rather than reactive.

Whereas ZTNA solutions in the market largely utilize "break-and-inspect" and AI-enabled firewalls to react to incoming attacks and exploits, Terniion fundamentally re-architectures the network to be naturally and preemptively resistant to a wide range of attacks. Terniion does not require enterprise-wide trust in vendors (unlike most ZTNA and SSO solutions) and does not federate sensitive directories or expose credentials anywhere in transit.

> Xiid was the first to leverage Zero Knowledge Proofs in the authentication and access markets, protecting credentials, identities, and enterprise data from theft, and is also one of the only companies to offer ZTNA functionality without requiring the federation of data to third-party data centers or infrastructure.

Inbound network traffic for resource access and authentication should be rejected

Client devices and the enterprise private network should not require open inbound firewall ports for authentication or resource access. Attackers frequently target open ports for vulnerabilities. All access to resources, no matter the resource, should be achieved using outbound-only traffic on both endpoints. Further, since all traffic is outbound-only, neither endpoint should require or need to share a public IP address.

Identity Access Management vendors may not obtain or store copies of directory identities

Authentication requests should be processed and actioned efficiently without federation to a third-party service. Copies of sensitive identity information in Identity Access Management (IAM) vendors' data centers are extremely risky and dramatically increase the enterprise attack surface. Taking this risk should not be necessary for an organization to securely authenticate its users.

Traffic should be encrypted with multiple, unique layers of encryption, and no intermediary entity should be able to obtain decryption keys

All traffic should be encrypted with multiple layers of encryption, with the encryption algorithms used varying across the layers. This variation is key, as it is far more difficult for an adversary who can defeat one type of encryption to defeat multiple. There must be at least three layers of quantum-secure encryption, and one of the inner layers must use an Authenticated Encryption with Associated Data (AEAD)-type encryption method.

In addition, decryption keys should not be shared with any entity that could be positioned to intercept network traffic. These measures prevent man-in-the-middle attacks, adversaries, and potentially compromised "break-and-inspect" vendors from deciphering traffic and enterprise data.

Authentication and access requests must leverage Zero Knowledge Proofs to enable verification without transmitting sensitive data

Stealable credentials (e.g., usernames and passwords) should never be sent over the internet as part of

the authentication process. Zero Knowledge Proofs make it possible to exceed the level of authentication used by Multi-Factor Authentication (MFA), which still requires the transmission of credentials, by securely authenticating users without sharing credentials at all. Zero Knowledge Proofs, until recently, only existed in academia. These algorithms now make it possible to prove a piece of information – such as an identity – without transmitting any sensitive knowledge to the verifier.[7]

Compliance with these tenets, in addition to the NIST Zero Trust Architecture, forms the highest-security commercial networking paradigm on the market. Terniion also takes a decentralized approach to resources, where no resource or system has authority over the entire network.

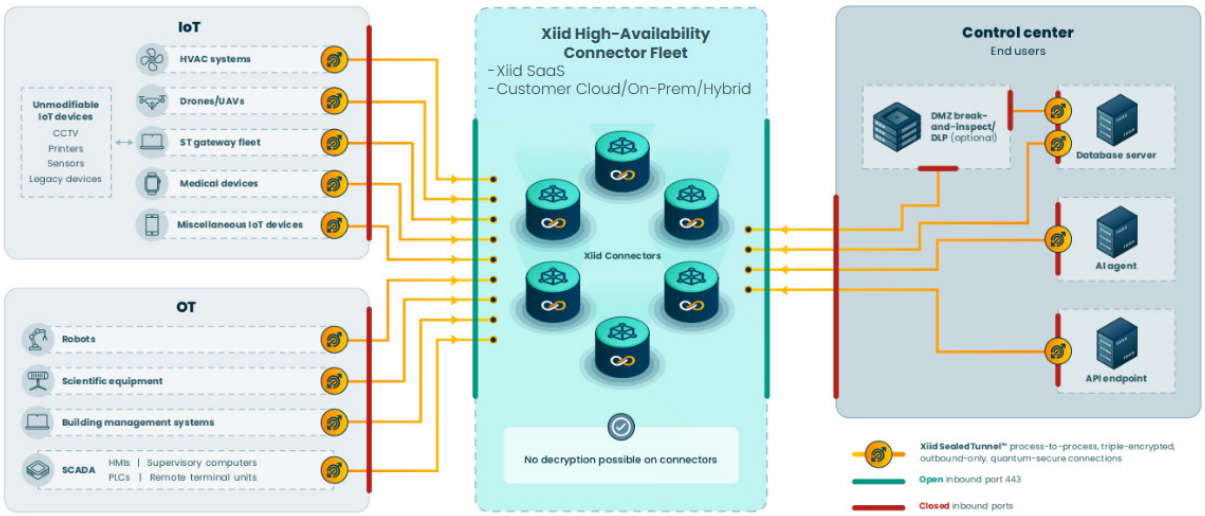
As cybercriminals become increasingly sophisticated, it may be tempting to implement "AI-enabled" products to try and outsmart adversaries. Terniion achieves a higher level of security without needing black-box AI algorithms by fundamentally redesigning the network in a way that structurally shrinks the enterprise attack surface to near zero, offering security, efficiency, transparency, and simplicity.

The Evolution of Security-First Architecture

Predominant players in the authentication and digital resource access market largely arose out of a need for functionality – that is, they delivered an urgently needed service in an evolving market. However, this meant that mitigating security concerns were an afterthought, and many products' designs became vulnerable as cybercriminals grew more sophisticated and new angles of attack emerged. Even those who fit the ZTNA model may still leave wide security gaps in their architecture.

Xiid's products were uniquely designed from the ground up and patented with a security-first architecture, in addition to meeting all NIST ZTNA guidelines.

Xiid also devised low-level security innovations that stop attacks before they happen or make them impossible, and that maintain unbreakable, multi-layer, end-to-end encryption while still guaranteeing that authentication requests do not contain extraneous malicious payloads.



7 https://codethechange.stanford.edu/guides/guide_zk.html

Xiid Zero Trust Application Control In Practice

Xiid ensures ultra-high security access to enterprise resources, delivering low-latency, double-encrypted, process-to-process tunneling between remote resources over any type of IP communication, including SSH and Remote Desktop Protocol/Virtual Desktop Infrastructure (RDP/VDI). In addition, since Xiid does not need to operate large data centers, it is able to offer solutions at a far lower cost than traditional ZTNA vendors.

XIID'S PRODUCTS EXCEED ZERO TRUST PRINCIPLES

Zero Trust Principle	Xiid Compliance
Inbound network traffic for resource access and authentication should be rejected	Xiid products do not require any use of inbound network traffic at any time and are capable of efficiently handling large numbers of concurrent users. As a result, endpoints using Xiid products do not require public IP addresses. In practice, two endpoints interacting via Xiid services are "triple-blind" in that neither party nor Xiid knows excessive information about the other nor the endpoints' locations.
Identity Access Management vendors may not obtain or store copies of directory identities	Xiid's cloud services can action IAM requests without collecting or requiring copies of enterprise data.
Traffic should be encrypted with multiple, unique layers of encryption, and no intermediary entity should be able to obtain decryption keys	Multiple layers of end-to-end encryption with varying algorithms between devices and enterprise infrastructure prevent Xiid, adversaries, or other "break-and-inspect" solutions from deciphering network traffic. Xiid's inner encryption layers leverage mlkem768-x25519 and AES-256 GCM in the AEAD family. At no point does Xiid require copies of encryption keys, ensuring that enterprise traffic stays safe even in the event of Xiid itself being compromised.
Authentication and access requests must leverage Zero Knowledge Proofs to enable verification without transmitting sensitive data	Xiid's XOTC™ Authenticator leverages Zero Knowledge Proofs and SHyPs™ to deliver secure, credential-less authentication.

As an example, RDP and VDI are widely used by call center and Managed Service Provider (MSP) employees who work remotely and need to access specialized enterprise tools and customer data.[8]

8 https://www.ibm.com/cloud/blog/what-is-virtual-desktop-infrastructure

Financial

Healthcare

Military

ZTNA products and VPNs currently used to facilitate remote resource access are vulnerable to the interception of customer information, and companies must trust the vendors of these products with safeguarding that information. In addition, adversaries that breach these vendors may gain access to large quantities of customer PII or even the enterprise tools themselves. Xiid's Terniion secures RDP/VDI without VPNs or the need for open inbound firewall ports on either the client machine or server.

Terniion's technology ensures that neither Xiid nor cybercriminals, even if Xiid's services were breached, would be able to decrypt the multiple layers of end-to-end encryption securing the RDP/VDI session.

Xiid's product suite has been penetration tested by the U.S. Air Force Research Laboratory (AFRL), and not only was the AFRL unable to breach Xiid's encryption, but their tests also demonstrated the "…near invisibility of the product externally." As a result, Xiid's products are now in use by several U.S. government agencies in the field to secure extremely sensitive data. Xiid has also earned a full DoD ATO through the Defense Health Agency (eMASS N-3551).

One agency's in-theater field operatives faced significant challenges in securely logging and transmitting highly sensitive health information with limited internet and command center access at remote sites. Xiid worked with the agency to create "flyaway kits" (briefcase servers) equipped with AclaveTM, Xiid's patented authentication management system, for secure authentication and access to medical record software through an Xiid-hosted Single Sign-On (SSO) portal. Field operatives can securely authenticate and log medical information through the flyaway kits, with Xiid ensuring the confidentiality, integrity, availability, and in-transit security of sensitive data from anywhere in the world.

Expanding upon ZTNA principles, Xiid's platform closes critical security gaps left by legacy solutions while dramatically reducing complexity and risk of today's security tech stacks. By eliminating the need for open inbound firewall ports, credential federation, or big-vendor trust, Xiid enables secure access to sensitive assets anywhere with no compromise of either control or affordability.

Designed by security engineers who've seen the limits of every "zero trust" promise, Xiid delivers practical preemptive security for modern organizations ready to get ahead of attacks instead of just reacting to them. This is proactive cybersecurity that actually works, wherever you do business.

For more information about enterprise cybersecurity defense with Xiid Terniion, visit xiid.com.